Military Spending and Economic Growth in the Peripheral Economies of Europe: A Causal Analysis for Greece, Spain and Portugal

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Abstract:

Tests for Granger causality have become an important tool for researchers investigating the relationship between military spending and growth. These analyses of the dynamics of the relationship have focused upon case studies of individual countries and studies of groups of relatively homogeneous countries. This paper contributes to the literature by considering three of the EU's poorest, peripheral economies Greece, Portugal and Spain. The impact of military spending is important for these countries as they do have an opportunity to reduce military expenditures if they benefit from improved security arrangements within the EU and Europe. This paper investigates the relation between military burden and growth for the countries, using Granger causality methods within a cointegrating VAR framework to improve upon previous analyses. The results from these different methods are not consistent and indicate the problems of drawing inferences across even relatively homogeneous economies. The cointegrating VAR results for Greece suggest a positive impact of military burden on growth, contrary to the negative effect for Spain, while for Portugal, there is no evidence of any causal links.

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1. Introduction

Greece, Spain and Portugal are the peripheral economies of the EU and share a number of characteristics. They have all emerged from dictatorial rule, seen considerable internal political and economic changes and a desire for international recognition. Their relative economic backwardness made them the poorest countries in the EU and undoubtedly one of the major challenges facing the EU is the improvement of the economic position of such economies, especially with the planned expansion eastwards. This has led to considerable interest in the economic development of these countries, but one important aspect of their economic development that has not attracted much interest is military spending. This constitutes a huge burden on these economies, especially Greece (5.6% of GDP during the last decade compared to NATO's average of 3.5% for the same period) and may bear some responsibility for the delayed progress of these economies[1].

In the post Cold War world the opportunity of reduced military expenditures may provide a means of improving the relative performance of these economies, especially if they benefit from improved security arrangements within the EU and Europe. This will of course only benefit the economies if military spending does not play a positive role in their economic development. Yet the economic effects of military spending remains a topic of considerable debate. This paper makes a contribution to the ongoing debate by investigating the relation between military burden and growth for Greece, Spain and Portugal using Granger causality techniques. Rather than simply using the common Engle-Granger two stage procedure, it uses a cointegrating VAR framework, which improves upon previous analyses by allowing for long run information in the data. It also compares the results from the different methods. The results from these different methods are not consistent and indicate the problems of drawing inferences across even relatively homogeneous economies.

Section 2, provides an outline of the development of the three economies and of their military expenditures. Section 3 briefly discusses the defence-growth nexus, section 4 introduces the methods used and presents some results. Finally, section 5 presents some conclusions.

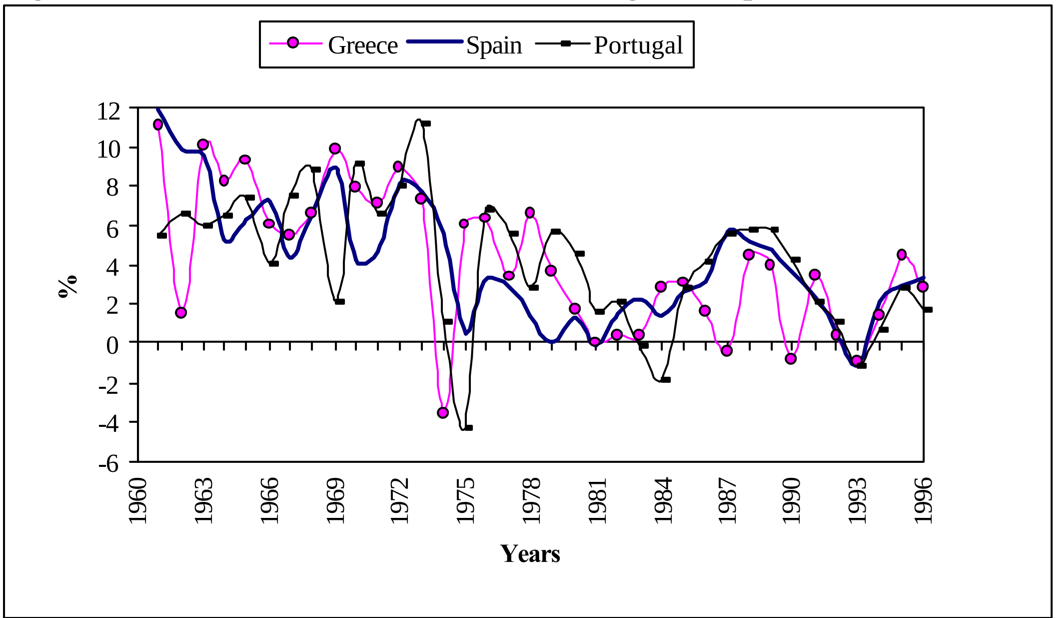
[1] Portugal was a big defence spender during the 1960s and 1970s mainly because of the need to keep its colonies but since then it gradually reduced its military burden. As for Spain and because it lost its colonies earlier than Portugal military burden is much lower than Greece's and Portugal's during the period examined (1960-1996).

2. Greece, Spain and Portugal

Greece, Spain and Portugal make an interesting group of countries for analysis. They have all emerged from dictatorial rule, which in the case of the two Iberian countries, lasted for several decades and as Tsoukalis (1981) observed *"had turned the three countries into observers of the international system"*. After more than a decade of uninterrupted growth in Western Europe, the recession of the mid-seventies also saw the collapse of the dictatorships in the three Mediterranean countries (mid-70s). The transition towards parliamentary democracy led to internal political and economic changes and a desire for international recognition. Starting with Greece the countries came to see membership of the European Community as a means of strengthening their economic and political situation. When they did join, their relative economic backwardness made them the poorest countries in the EU.

There are many similarities in terms of their economic performance but at the same time some differences in terms of the pattern of their military expenditure. Figure 1, shows the real growth of GDP for the three countries from 1960-96, illustrating the similar patterns for the countries, with Spain performing slightly better over the period.

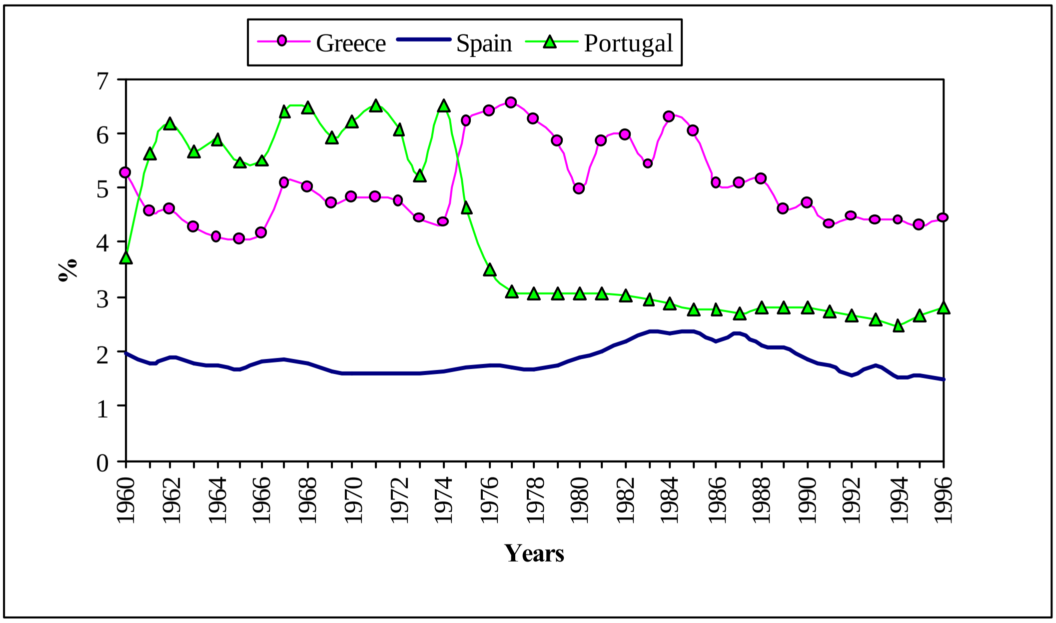
Figure 1. Real Growth of GDP for Greece, Portugal and Spain*



*calculated from figures in 1990 mn US $
Source: World Bank

During the period 1960-1973 all three countries enjoyed higher rates of growth than the rest of the EC or even any individual member country, with low inflation and unemployment rates (Tsoukalis, 1981). This situation was soon followed by a period of both high inflation and unemployment, with unemployment particularly high in Spain. This depression in the early 1970s which coincided with the collapse of the dictatorships in all three countries (for Greece these coincided with the Turkish invasion of Cyprus as well), is reflected in the negative growth of GDP, reaching at around -4% for Greece and Portugal in 1974 and 1975, respectively, while Spain managed to avoid the "below zero" rate. This crisis led to a huge drop in investment for all the countries and substantial increases in Government debt after 1975, a problem that has become more serious over the last two decades, especially for Greece.

Figure 2. Military Burden for Greece, Portugal and Spain



Source: SIPRI

As Figure 2 shows there are clear differences in the evolution of the countries military burden. Spain had throughout the period the lowest military burden among the three countries, and it remained stable at around 2% of GDP, with a slight increase in the 1980s (due to the development of the arms industry and the expansion of production). But when it comes to Portugal and Greece, things are quite different. Clearly, 1974 was a critical year for both countries, as can be seen from Figure 2. Portugal had a high military burden (higher than Greece) for the years prior to 1974 and after that a dramatically decreased one. Exactly the opposite pattern is observed for Greece that before 1974 had a lower military burden compared to the years after 1974. The reduction of the Portuguese military burden after 1974 was attributed to the end of the dictatorship but most importantly to the end of the Colonial Empire. For Greece, the Turkish invasion of Cyprus in 1974 marked a huge increase in military burden, which has remained high since then due to continuous disagreements and conflicts with the neighbouring country. These features are particularly important when analysing empirically the defence-growth relationship.

3. Analysing the Military Spending-Growth nexus

Most of the studies on the defence-growth relationship are based on the Neoclassical[2] or Keynesian[3] theoretical frameworks, which allow the development of consistent formal models. While Neoclassical models concentrate on supply-side (modernisation, positive externalities from infrastructure, technological spin-offs), Keynesian models concentrate on demand-side (crowding-out of investment, exports, education, health). In order to overcome the problem of concentrating on the demand or supply-side only, efforts to include both influences have been made. These models capture the demand-side influences in a Keynesian aggregate demand function and the supply-side ones in a growth equation, which is derived from a production function. This framework was first developed by Smith and Smith (1980) and since then further developed by Deger and Smith (1983), Deger (1986), Antonakis (1997), Dunne and Nikolaidou (1999), Dunne, Nikolaidou and Roux (2000) and others. These models hypothesise possible direct effects of defence on growth through Keynesian demand stimulation and other spin-off effects and negative indirect effect through reductions in savings or investment. They usually include three or four equations one of which is a growth equation and the others a savings or investment equation, a trade balance ratio and a defence burden one. Although these models provide a more complete picture of the defence-growth relationship by

[2] Examples of Neoclassical studies include: Biswas and Ram (1986), Alexander (1990), Mintz and Huang (1990), Mintz and Stevenson (1995), Sezgin (1996), Murdoch, Pi and Sandler (1997), Nikolaidou (1998a).

[3] Examples of Keynesian studies include: Smith (1980), Lim (1983), Faini, Annez and Taylor (1984), Chletsos and Kollias (1995).

accounting for the interrelationships between the variables, they have been criticised for not being strongly based on theory and thus, relying on more ad-hoc justifications.

An alternative approach, is to examine the series without developing a structural model. Using Vector Autoregressive (VAR) models has the advantage that they are dynamic specifications, free of economic assumptions imposed a priori. Thus, they allow for the testing of causal linkages without the need to first construct arguments and develop hypotheses justifying those linkages (Georgiou et al., 1996). Research into direction of statistical (Granger) causality[4] between defence and growth has become a commonly used method in the literature. Researchers, such as Kinsella and Chung (1998) and Dunne and Vougas (1999), began to develop the analysis to allow for long run information in the data. In their analysis of South Africa, Dunne and Vougas(1999) found that this changed the results from an insignificant positive Granger causality from military burden to growth to a significant negative one. They argued that failing to take account of the long run information led to misspecification of the estimating equation. But although they used a VAR framework for their analysis, they employed the Engle-Granger simple two-stage cointegration procedure and this has been superseded in the literature by the Johansen's cointegrating VAR framework. This paper uses the latter approach and compares it with the other two methods.

4. VARs, Cointegration and Stationarity

Prior to applying Granger causality tests we need to establish the integration properties of the time series. To do so we apply the Dickey-Fuller (1979) unit root tests (DF), using an autoregression that includes only an intercept or both an intercept and a linear trend. For the first case, where only an intercept is included, we have the following autoregression:

$$\Delta x_t = \beta_0 + \alpha_1 x_{t-1} + \sum_{i=1}^{k} a_i \Delta x_{t-i} + \varepsilon_t \qquad \textbf{(1)}$$

and for the second case (both an intercept and a linear trend is included), we have:

[4] Examples of Granger causality studies include: Joerding (1986), Chowdhury (1991), Chen (1993), Kollias & Makrydakis (1997), Dunne, Nikolaidou and Vougas (1998)

$$\Delta x_t = \beta_0 + \beta_1 t + \alpha_1 x_{t-1} + \sum_{i=1}^{k} a_i \Delta x_{t-i} + \varepsilon_t \qquad \textbf{(2)}$$

In both cases the null hypothesis of a unit root is the same (H_0: $a_1 = 0$) but the critical values differ. In order to select the maximum lag order[5], k, we have to consult some information criteria, which can give contradictory results.

Table A1 in the Appendix presents the DF tests for unit roots when only an intercept is included, when both an intercept and a linear trend are included as well as when the data is first differenced for the Greek, Spanish and Portuguese series for the logarithm of GDP (Y_t) and the military burden (SM_t). According to these results, when either an intercept or an intercept and a trend are included, the null hypothesis of no unit root is rejected for all the series, which seem to be I(1) or non-stationary. To justify this, we also test for unit roots for the differenced series. If the differenced series are proved to be stationary, then by induction, the level series are I(1), that is integrated of order one. If on the other hand, the differenced series are still non-stationary, but the second differenced series are stationary that means that the levels series are I(2) and so on. For all the first differenced series the hypothesis of a unit root is rejected at 95% level of significance. So, we can say with confidence that the levels series are I(1).

Now that we have established the integration properties of the series, we can examine whether there is a long-run relationship between the variables in question. In other words we can test for the existence of cointegration between GDP and military burden for Greece, Spain and Portugal. We test for cointegration using Johansen's (1988) cointegration method. We estimate a VAR(2) model for each country (see Tables A2, A3 and A4 in the Appendix for the criteria of selecting the order of VAR). Tables A5, A6 and A7 in the Appendix, give two tests for cointegration - the Likelihood Ratio test based on the maximum Eigenvalues of the stochastic matrix and the one based on the Trace of the stochastic matrix - for Greece, Spain and Portugal respectively. For each country, the null hypothesis of no cointegration (H_0: r=0) is rejected by both tests in favour of the alternative (r=1), indicating that there is one

[5] Lagged differences of the series are added to "whiten" the error of the autoregressions

cointegrating vector in all the series. Results from a VAR(1) model point to the same conclusions.

The existence of one cointegrating vector between the series in question (the log of GDP and military burden) should be taken into consideration when we examine the short-run causality between the variables. To find the direction of the causality we have to apply the standard Granger tests augmented by the error correction term (ECT) which is derived from the long-run cointegrating relationships. The ECT is nothing more than the lagged value of the estimated residuals from each of the following cointegrating regressions:

For Greece: $$Y_t = \underset{(80.79)}{24.19} + \underset{(2.86)}{0.16}\, SM_t + \varepsilon_t \qquad \textbf{(3)}$$

For Spain: $$Y_t = \underset{(55.78)}{26.48} + \underset{(2.19)}{0.05}\, SM_t + \varepsilon_t \qquad \textbf{(4)}$$

For Portugal: $$Y_t = \underset{(222.1)}{25.73} - \underset{(8.59)}{0.20}\, SM_t + \zeta_t \qquad \textbf{(5)}$$

(t-ratios in parentheses)

The cointegrating series can then be modelled in a VAR specification. The choice of the VAR's order (the lag-length) was based on the Akaike's final prediction error. For all three countries a second order VAR model is accepted (see Tables A2, A3 and A4 in the Appendix).

4.1. The Three Specifications of the VAR Models

Three specifications of the VAR models for Greece, Spain and Portugal are presented:

1. The standard Granger causality test (that is we ignore the existence of cointegration)
2. The Granger causality test augmented by the error correction term derived from the cointegrating regressions (that is we take into account the existence of cointegration)
3.The above specification further augmented with some dummy variables that capture important changes due to specific events in the three countries. Specifically, for Greece a dummy for 1975 (the year after the Turkish invasion of Cyprus in 1974) is introduced which had a significant impact on military burden. For Spain a dummy for 1982-88 that captures the increased military burden (during this period war broke out between Britain and Argentina

over the Falkland islands and Spain supported Argentina's claims, it took active part in Condadora group and was very successful in arms exports to Middle East and Latin America). Finally, for Portugal a dummy for the period 1960-1974 (the period of the dictatorship which was accompanied by increased military spending) is introduced.

The standard Granger causality test (when cointegration is not taken into account) assumes that the information for the prediction of the variables X_t and Z_t is contained only in the time-series data of these variables. The test involves estimating the following regressions:

$$X_t = \sum_{i=1}^{k} \alpha_i Z_{t-i} + \sum_{j=1}^{k} \beta_j X_{t-j} + u_{1t} \qquad \textbf{(6)}$$

$$Z_t = \sum_{i=1}^{m} \lambda_i Z_{t-i} + \sum_{j=1}^{m} \delta_j X_{t-j} + u_{2t} \qquad \textbf{(7)}$$

Equation 6 postulates that current X is related to past values of X itself as well as of Z and equation 7 postulates a similar behaviour for Z. Generally, if Z Granger causes X, then changes in Z should precede changes in X. Therefore, in a regression of X on other variables (including its own past values) if we include past or lagged values of Z and it significantly improves the prediction of X, then we can say that Z Granger causes X. A similar definition if X Granger causes Z. An important feature of the Granger causality tests is that they presume the use of stationary data. Since our level variables are I(1), we have to use their first differences which are I(0). So, the VAR(2) for Greece (similar for Spain and Portugal) when cointegration is ignored is:

$$\Delta Y = a_0 + a_1 \Delta Y(-1) + a_2 \Delta Y(-2) + a_3 \Delta SM(-1) + a_4 \Delta SM(-2) + u \qquad \textbf{(8)}$$

$$\Delta SM = \beta_0 + \beta_1 \Delta SM(-1) + \beta_2 \Delta SM(-2) + \beta_3 \Delta Y(-1) + \beta_4 \Delta Y(-2) + \varepsilon \qquad \textbf{(9)}$$

The null hypothesis in equation 8 is that $\Delta SM(-1)$ and $\Delta SM(-2)$ do not Granger cause ΔY (H_0: $a_3 = a_4 = 0$) and in equation 9 that $\Delta Y(-1)$ and $\Delta Y(-2)$ do not Granger cause ΔSM (H_0: $\beta_3 = \beta_4$

= 0). The standard Granger causality tests (see Tables 8, 9 and 10 in the Appendix) show the existence of unidirectional causality from military burden to growth with a positive effect for Greece, absence of any causal relationship between the two variables for Spain while for Portugal they point to the existence of unidirectional causality from growth to military burden with a positive effect.

To take into account the long-run relationship that exists between growth and military burden, we have to include the ECT from equations 3, 4 and 5 in the Granger causality tests. Following these, the VAR(2) model for Greece (similar for Spain and Portugal) is:

$$\Delta Y = a_0 + a_1\, \Delta Y(-1) + a_2\, \Delta Y(-2) + a_3\, \Delta SM(-1) + a_4\, \Delta SM(-2) + ECT(-1) + u \qquad \textbf{(10)}$$

$$\Delta SM = \beta_0 + \beta_1\, \Delta SM(-1) + \beta_2\, \Delta SM(-2) + \beta_3\, \Delta Y(-1) + \beta_4\, \Delta Y(-2) + ECT(-1) + \varepsilon \qquad \textbf{(11)}$$

In equation 10, the null hypothesis is that $\Delta SM(-1)$ and $\Delta SM(-2)$ do not Granger cause ΔY, (H_0: $a_3 = a_4 = 0$) and in equation 11 that $\Delta Y(-1)$ and $\Delta Y(-2)$ do not Granger cause ΔSM (H_0: $\beta_3 = \beta_4 = 0$). For Greece, the introduction of the ECT removes the positive effect, so now, there is absence of any causal relationship between the variables. But in the case of Portugal and Spain the inclusion of the ECT has not altered the previous results (see Tables A8, A9, and A10 in the Appendix).

Finally we consider the inclusion of the dummy variables (mentioned previously) in the VAR models for the three countries in order to account for structural breaks. For Greece, the Turkish invasion of Cyprus in 1974 had a significant positive effect on military burden. For Portugal, the dictatorship years (1960-74) influenced growth positively but had no significant effect on military burden and for Spain the years 1982-88 had a significant positive effect on military burden.

The final equations (augmented by the ECT and the dummies) are:

$$\Delta Y = a_0 + a_1\, \Delta Y(-1) + a_2\, \Delta Y(-2) + a_3\, \Delta SM(-1) + a_4\, \Delta SM(-2) + ECT(-1) + a_5\, D + u \qquad \textbf{(12)}$$

$$\Delta SM = \beta_0 + \beta_1\, \Delta SM(-1) + \beta_2\, \Delta SM(-2) + \beta_3\, \Delta Y(-1) + \beta_4\, \Delta Y(-2) + ECT(-1) + \beta_5\, D + u \qquad \textbf{(13)}$$

The results that we get from this specification (see Tables 8, 9 and 10 in the Appendix) are very similar to the previous ones for Greece and Spain (absence of causality). But for Spain the inclusion of the dummy has removed the positive effect from growth to military burden. So, the third specification points to the absence of any causal relationship between the variables in question for all three countries.

4.2. Cointegrating VAR Approach

It has been claimed (see Harris, 1995) that unit roots tests often suffer from poor size and power properties (i.e. the tendency to over-reject the null hypothesis of non-stationarity when it is true and under-reject the null when it is false, respectively). This has meant that in practical applications, it is quite common for there to be tests for cointegration even when the preceding unit root analysis suggests that the properties of the variables in the equation are unbalanced (ie. They cannot cointegrate down to a common lower order of integration). This might be justified on the grounds that the unit root tests are not reliable, and consequently the variables may indeed all be, say, I(1). However, it is not necessary for all the variables in the model to have the same order of integration. So, although we have already tested for the integration properties of the series (as it was necessary for the previous approach) had we started with Johansen's approach there would be no need to do so. Using this approach, we test for a cointegrating relationship and if one exists, we impose restrictions on the vector and estimate the restricted Error Correction Models (ECMs).

The reduced form of the system for GDP (Y) and the share of military expenditure in GDP (SM) for the three countries can be written in VECM (Vector Error Correction Model) form of a first order VAR (Vector Autoregression) specification (see Smith et al, 1999) as:

$$\Delta Y_t = \delta_{11} + \delta_{12} Y_{t-1} + \delta_{13} SM_{t-1} + u_{1t} \qquad \textbf{(14)}$$

$$\Delta SM_{2t} = \delta_{21} + \delta_{22} Y_{t-1} + \delta_{23} SM_{t-1} + u_{2t} \qquad \textbf{(15)}$$

where $E(u_{it}) = 0$, $E(u^2_i) = \omega^2_i$, $E(u_{it}u_{jt}) = \omega_{ij}$, $E(u_{it}u_{jt-s}) = 0$, where $s \neq 0$ and i, j =1,2.

There will be Granger (1969) causality from Y to SM if $\delta_{22} \neq 0$ and from SM to Y if

$\delta_{13} \neq 0$. If the long-run relationship is $Y_t = \beta SM_t$, then the disequilibrium is measured by $z_t = Y_t - \beta SM_t$ and the VECM takes the form:

$\Delta Y_t = \delta_{11} + \alpha_1 z_{t-1}$ **(16)**

$\Delta SM_t = \delta_{21} + \alpha_2 z_{t-1}$ **(17)**

where the feedbacks are stabilising if $\alpha_1 < 0$ and $\alpha_2 > 0$.

Greece

Starting with Greece and as we have seen on Table A5, testing for cointegration with unrestricted intercepts and restricted trends both the LR tests (the one based on the maximal eigenvalue and the other based on the trace of the stochastic matrix) reject the null hypothesis of no cointegration in favour of the alternative (one cointegrating vector). Furthermore, the Schwarz criterion also points to the existence of one CV (see Table A5 in the Appendix).

There is a positive long-run solution: Y= 0.36 M + 0.08 Trend **(18)**

And the ECMs are:

$\Delta Y_t = -0.52 + 0.05\,\Delta Y_{t-1} + 0.02\,\Delta SM_{t-1} - 0.03\,Z_{t-1} - 0.01 D75_t$ **(19)**
(2.91) (0.32) (2.19) (3.04) (0.82)

$R^2 = 0.41$; SER=0.03; DW=1.83

$\Delta SM_t = -12.38 - 11.63\,\Delta Y_{t-1} + 0.02\,\Delta SM_{t-1} - 0.59\,Z_{t-1} + 0.43\,D75_t$ **(20)**
(3.87) (3.82) (0.15) (3.90) (1.91)

$R^2 = 0.42$; SER=0.48; DW=2.25

(t-ratios in brackets)

Imposing the restrictions that the coefficients of ΔSM_{t-1} (in equation 19) and ΔY_{t-1} (in equation 20) are zero, were rejected by the Wald test which gave X^2 (1)= 4.80 [.028] and X^2 (1)= 14.56 [.000], respectively. That means that there is positive short-run effect from military burden on growth and a negative effect from growth to military burden.

To test whether the trend was significant, we imposed the overidentifying restriction on the CV that a3=0. The LR test gave a X^2 (1)= 3.57 [.059], suggesting that at 5% level of significance we can accept the restriction that the trend can be excluded. Surprisingly, the long-run solution without the trend is negative:

$Y = -\ 0.14\ SM$ **(21)**

The error correction models are:

$$\Delta Y_t = \underset{(3.49)}{1.01} + \underset{(0.28)}{0.04}\ \Delta Y_{t-1} + \underset{(2.08)}{0.02}\ \Delta SM_{t-1} + \underset{(3.41)}{0.04}\ Z_{t-1} - \underset{(0.16)}{0.01} D75_t \quad \textbf{(22)}$$

R^2 =0.44; SER=0.03; DW=1.85

$$\Delta SM_t = \underset{(3.04)}{17.25} - \underset{(3.13)}{10.02}\ \Delta Y_{t-1} - \underset{(0.07)}{0.01}\ \Delta SM_{t-1} + \underset{(3.02)}{0.65}\ Z_{t-1} + \underset{(2.36)}{0.58}\ D75_t \quad \textbf{(23)}$$

R^2 =0.33; SER=0.52; DW=2.07

(t-ratios in brackets)

The restrictions that the coefficients of ΔSM_{t-1} (in equation 22) and ΔY_{t-1} (in equation 23) are zero were again rejected (X^2 (1)= 4.34 [.037] and X^2 (1)= 9.79 [.002] respectively). These results suggest that for Greece there is a 'causal' link both ways, with a significant positive relation between military burden and growth.

Spain

Moving on to the Spanish series, we test for cointegration with unrestricted intercepts and restricted trends. The results suggest the existence of a cointegrating relationship (see Table 5 in the Appendix). There is a negative long-run relationship between GDP growth and military burden which is:

$Y = -\ 2.25\ SM - 0.03\ Trend$ **(27)**

With the error correction model results:

$$\Delta Y_t = \underset{(1.86)}{0.33} + \underset{(3.77)}{0.53}\ \Delta Y_{t-1} - \underset{(0.43)}{0.01}\ \Delta SM_{t-1} + \underset{(1.80)}{0.01}\ Z_{t-1} + \underset{(1.63)}{0.02}\ D6074_t \quad \textbf{(28)}$$

R^2 =0.57; SER=0.02; DW=2.13

$$\Delta SM_t = \underset{(3.92)}{3.72} - \underset{(2.95)}{2.24}\,\Delta Y_{t-1} - \underset{(1.65)}{0.26}\,\Delta SM_{t-1} + \underset{(3.92)}{0.12}\,Z_{t-1} + \underset{(3.13)}{0.20}\,D6074_t \qquad \textbf{(29)}$$

R^2 =0.35; SER=0.10; DW=1.98

(t-ratios in brackets)

The restriction that the coefficient of ΔSM_{t-1} is zero cannot be rejected X^2 (1)=0.18 [.667]. So, for Spain there is no significant short-run effect from military burden to growth. Imposing the restriction on equation 29 that the coefficient of ΔY_{t-1} is equal to zero gave a X^2 (1)= 8.70 [.003] suggesting that this restriction is rejected and as such there is a significant negative effect from growth to defence. Testing for the significance of the trend, we set the overidentifying restriction that the coefficient of the trend is equal to zero, which is accepted by the data, X^2 (1)= 0.44 [.506], so the trend can be excluded from the vector. In this case the long-run solution becomes:

$$Y = -\,1.2\ SM \qquad \textbf{(30)}$$

which has the same negative effect as before but slightly smaller coefficient on SM. The ECMs without the trend are:

$$\Delta Y_t = \underset{(2.07)}{0.62} + \underset{(3.59)}{0.51}\,\Delta Y_{t-1} - \underset{(0.43)}{0.01}\,\Delta SM_{t-1} + \underset{(2.04)}{0.02}\,Z_{t-1} + \underset{(1.78)}{0.02}\,D6074_t \qquad \textbf{(31)}$$

R^2 =0.58; SER=0.02; DW=2.12

$$\Delta SM_t = \underset{(3.64)}{6.08} - \underset{(2.82)}{2.22}\,\Delta Y_{t-1} - \underset{(1.46)}{0.23}\,\Delta SM_{t-1} + \underset{(3.64)}{0.21}\,Z_{t-1} + \underset{(2.89)}{0.19}\,D6074_t \qquad \textbf{(32)}$$

R^2 =0.32; SER=0.10; DW=1.96

Again the restriction that the coefficient of ΔSM_{t-1} is zero cannot be rejected X^2 (1)=0.19 [.664] and the restriction that the coefficient of ΔY_{t-1} is zero is rejected, X^2 (1)=7.94 [.005].

Portugal

Finally, testing for cointegration with unrestricted intercepts and restricted trends for the Portuguese series, again one cointegrating relation exists (see Table A7 in the Appendix). This gives the long-run solution:

$$Y = 0.31\ SM + 0.05\ Trend \qquad \textbf{(33)}$$

And the results for the error correction models:

$$\Delta Y_t = \underset{(0.52)}{-0.29} + \underset{(0.04)}{0.01}\ \Delta Y_{t-1} - \underset{(1.29)}{0.01}\ \Delta SM_{t-1} - \underset{(0.57)}{0.01}\ Z_{t-1} + \underset{(1.86)}{0.05}D6074_t \qquad \textbf{(34)}$$

R^2 =0.33; SER=0.03; DW=1.74

$$\Delta SM_t = \underset{(8.75)}{-54.65} - \underset{(0.96)}{2.10}\ \Delta Y_{t-1} + \underset{(1.87)}{0.15}\ \Delta SM_{t-1} - \underset{(8.70)}{2.39}\ Z_{t-1} + \underset{(8.17)}{2.41}\ D6074_t \qquad \textbf{(35)}$$

R^2 =0.74; SER=0.31; DW=2.19
(t-ratios in brackets)

The restriction that the coefficient of ΔSM_{t-1} is zero cannot be rejected X^2 (1)=1.67[.197] and the restriction that the coefficient of ΔY_{t-1} is zero cannot be rejected X^2 (1)=0.92 [.338]. So, for Portugal there is no significant short-run effect from military burden to growth, nor from growth to military burden. Imposing the overidentifying restriction that the coefficient of the trend is zero gave a X^2 (1)=9.6 [.002], this restriction is rejected or in other words the trend is significant and should not be excluded.

5. Conclusions

This paper has investigated the relationship between economic growth and military burden in the three peripheral countries of the European Union, Greece, Spain and Portugal. These countries share common economic characteristics, in being relatively poor countries in the EU and having suffered from military dictatorships, though they have some marked differences in their security environment -with Portugal involved in colonial conflicts and Greece in a confrontation with its neighbour Turkey. Their economic similarities and security differences make them an interesting object of analysis as they represent the relatively homogeneous groups of countries that much of the recent work in the area has focused. In the empirical analysis the paper also went beyond the usual tests of Granger causality used in the literature, using a VAR methodology to allow for cointegration between the variables. In addition, the possibility of important structural breaks in the data was investigated and attempts made to deal with them.

Table 1 summarises the empirical results and shows both variations across countries and that the different methods do indeed produce different results.

Table 1. Summary of results

Approach	**Country**	**SM ® Y**	**Y® SM**
Short-run Granger causality:	**Greece**	Yes (positive)	No
	Spain	No	No
	Portugal	No	Yes (positive)
Short-run Granger causality with ECT:	**Greece**	No	No
	Spain	No	No
	Portugal	No	Yes (positive)
Short-run Granger causality with ECT and dummy:	**Greece**	No	No
	Spain	No	No
	Portugal	No	No
Johansen framework	**Greece**	Yes (positive)	Yes (negative)
	Spain	No	Yes (negative)
	Portugal	No	No

When the simple Granger causality tests were used, only Greece and Portugal showed any significant relation (a positive effect of military burden on growth for Greece and a positive effect of growth on military burden for Portugal). But when the long run information was introduced using the two-stage procedure this disappeared for the case of Greece. Taking account of possible structural breaks in the data using dummy variables, suggested absence of any causal relation between the two variables for all countries. When the analysis was undertaken within the Johansen framework there were a number of changes. Greece exhibited a positive impact of military burden on growth and a negative one the other way. In contrast, Spain had a negative impact of growth on military burden, while the results for Portugal remained the same with no evidence of any 'causal' link. It is also worth noting that these results are rather different to those found by Nikolaidou (1998b) on slightly shorter time period.

Overall, there is no general empirical conclusion that can be drawn as to the economic effects of military spending on such small industrialised economies. The results show the difficulty of making judgements on the economic effects of military spending even across a group of relatively homogeneous countries. They also illustrate the difficulties in using Granger causality analyses and suggest that it is important that the long run information in the data is taken into account. While the use of the cointegrating VAR methods is a considerable improvement on earlier methods, it is clear that the techniques must be used with care as results can be sensitive to changes in the sample period and to structural breaks.

APPENDIX

Table A1. DF and ADF tests for unit roots

		With intercept	With intercept & trend	1st difference (with intercept)
Greece	Y	✗	✗	✔
	SM	✗	✗	✔
Spain	Y	✗	✗	✔
	SM	✗	✗	✔
Portugal	Y	✗	✗	✔
	SM	✗	✗	✔

✗ : reject the null hypothesis of no unit roots
✔ : accept the null hypothesis of no unit roots

Table A2. Determining the order of the VAR model for Greece

1966-97. Order of VAR=6, Variables included:Y, SM Exogenous: Constant

Order	LL	AIC	SBC	LR	LR Adjusted
6	64.1444	38.1444	19.0898	----	-----
5	62.0708	40.0708	23.9477	X^2 (4)= 4.15 [.386]	2.46 [.651]
4	57.6262	39.6262	26.4345	X^2 (8)= 13.04 [.111]	7.74 [.459]
3	53.7712	39.7712	29.5110	X^2 (12)=20.75 [.054]	12.32[.420]
2	53.4078	**43.4078**	36.0791	X^2 (16)=21.47[.161]	12.75[.691]
1	47.7959	41.7959	**37.3987**	X^2 (20)=32.70[.036]	**19.41[.495]**
0	-53.1526	-55.152	-56.6184	X^2 (24)=234.59 [.000]	139.29 [.000]

Table A3. Determining the order of the VAR model for Portugal

1966-97. Order of VAR=6, Variables included:Y, SM Exogenous: Constant

Order	LL	AIC	SBC	LR	LR Adjusted
6	58.0679	32.0679	13.0133	----	-----
5	57.0994	35.0994	18.9763	X^2 (4)= 1.94 [.747]	1.15 [.886]
4	51.3271	33.3271	20.1355	X^2 (8)= 13.48 [.096]	8.00 [.433]
3	49.9262	35.9262	25.6661	X^2 (12)=16.28 [.179]	9.67 [.645]
2	48.5878	**38.5878**	31.2591	X^2 (16)=18.96[.271]	11.26[.793]
1	43.1349	37.1349	**32.7377**	X^2 (20)=29.87[.072]	**17.73[.605]**
0	-48.2308	-50.230	-51.70	X^2 (24)=212.60 [.000]	126.23 [.000]

Table A4. Determining the order of the VAR model for Spain

1966-97. Order of VAR=6, Variables included:Y, SM Exogenous: Constant					
Order	**LL**	**AIC**	**SBC**	**LR**	**LR Adjusted**
6	120.3424	94.3424	75.2879	----	-----
5	118.8251	96.8251	80.7021	X^2 (4)= 3.03 [.552]	1.80 [.772]
4	116.8509	98.8509	85.6593	X^2 (8)= 6.98 [.538]	4.15 [.844]
3	116.0508	102.050	91.7907	X^2 (12)=8.58 [.738]	5.10 [.955]
2	112.2898	**102.289**	94.9611	X^2 (16)=16.11[.446]	9.56 [.888]
1	106.1957	100.195	**95.7985**	X^2 (20)=28.29[.103]	**16.80[.666]**
0	-8.8070	-10.807	-12.2727	X^2 (24)=258.30 [.000]	153.36 [.000]

Table A5. Cointegration Tests for Greek Y and SM

Cointegration with unrestricted intercepts and restricted trends in the VAR

36 observations from 1962 to 1997. Order of VAR = 2
List of variables included in the cointegrated vector:Y, SM, Trend
List of I(0) variables included in the VAR: D75
List of eigenvalues in descending order: .49073 .14850 0.0000

Cointegration LR test based on Maximal Eigenvalue of the stochastic matrix

Null	Alternative	Statistic	95% critical value	90% critical value
r = 0	r = 1	**24.2917**	19.2200	17.1800
r <= 1	r = 2	5.7873	12.3900	10.5500

Cointegration LR test based on Trace of the stochastic matrix

Null	Alternative	Statistic	95% critical value	90% critical value
r = 0	r >= 1	**30.0791**	25.7700	23.0800
r <= 1	r = 2	5.7873	12.3900	10.5500

Choice of r using Model Selection Criteria

Rank	Max. LL	AIC	SBC	HQC
r=0	47.5769	39.5769	33.2428	37.3661
r=1	59.7227	47.7227	**38.2216**	44.4066
r=2	62.6164	48.6164	37.5317	44.7475

AIC = Akaike Information Criterion SBC = Schwarz Bayesian Criterion
HQC = Hannan-Quinn Criterion

Table A6. Cointegration Tests for Spanish Y and SM

Cointegration with unrestricted intercepts and restricted trends in the VAR				
36 observations from 1962 to 1997. Order of VAR = 2				
List of variables included in the cointegrated vector:Y, SM, Trend				
List of I(0) variables included in the VAR: D8288				
List of eigenvalues in descending order: .46511 .13156 0.0000				
Cointegration LR test based on Maximal Eigenvalue of the stochastic matrix				
Null	Alternative	Statistic	95% critical value	90% critical value
r = 0	r = 1	**22.5249**	19.2200	17.1800
r <= 1	r = 2	5.0782	12.3900	10.5500
Cointegration LR test based on Trace of the stochastic matrix				
Null	Alternative	Statistic	95% critical value	90% critical value
r = 0	r >= 1	**27.6031**	25.7700	23.0800
r <= 1	r = 2	5.0782	12.3900	10.5500
Choice of r using Model Selection Criteria				
Rank	Max. LL	AIC	SBC	HQC
r=0	119.1826	111.1826	104.8485	108.9719
r=1	130.4451	118.4451	**108.9439**	**115.1289**
r=2	132.9842	**118.9842**	107.8995	115.1153

Table A7. Cointegration Tests for Portuguese GDP and Military Burden

Cointegration with unrestricted intercepts and restricted trends in the VAR				
36 observations from 1962 to 1997. Order of VAR = 2				
List of variables included in the cointegrated vector:Y, SM, Trend				
List of I(0) variables included in the VAR: D6074				
List of eigenvalues in descending order: .71672 .094534 0.0000				
Cointegration LR test based on Maximal Eigenvalue of the stochastic matrix				
Null	Alternative	Statistic	95% critical value	90% critical value
r = 0	r = 1	**45.4079**	19.2200	17.1800
r <= 1	r = 2	3.5750	12.3900	10.5500
Cointegration LR test based on Trace of the stochastic matrix				
Null	Alternative	Statistic	95% critical value	90% critical value
r = 0	r >= 1	**48.9829**	25.7700	23.0800
r <= 1	r = 2	3.5750	12.3900	10.5500
Choice of r using Model Selection Criteria				
Rank	Max. LL	AIC	SBC	HQC
r=0	51.4682	43.4682	37.1341	41.2575
r=1	74.1722	62.1722	**52.6711**	**58.8560**
r=2	75.9597	**61.9597**	50.8751	58.0908

AIC = Akaike Information Criterion   SBC = Schwarz Bayesian Criterion
HQC = Hannan-Quinn Criterion

Table A8. Granger Causality : VAR(2) for Greece

	Dependent DY			Dependent DSM		
	Eq. 8	**Eq. 10**	**Eq. 12**	**Eq. 9**	**Eq. 11**	**Eq. 13**
DY(-1)	0.31	0.14	0.26	-5.73	-5.63	0.68
	(1.86)*	(0.89)	(1.41)	(1.64)	(1.47)	(0.19)
DY(-2)	0.33	0.11	0.04	4.71	4.85	0.83
	(2.13)**	(0.70)	(0.25)	(1.42)	(1.25)	(0.24)
DSM(-1)	0.02	0.01	0.01	0.13	0.14	0.05
	(1.96)*	(0.79)	(0.61)	(0.75)	(0.70)	(0.32)
DSM(-2)	-0.01	-0.01	-0.01	-0.05	-0.05	-0.04
	(0.04)	(0.43)	(0.43)	(0.27)	(0.25)	(0.29)
Intercept	0.01	0.03	0.03	0.04	0.03	-0.11
	(1.57)	(3.08)***	(2.79)	(0.25)	(0.14)	(0.56)
ECT(-1)	____	-0.05	-0.05	____	0.03	0.08
		(2.77)***	(2.75)***		(0.07)	(0.22)
D75	____	____	0.04	____	____	2.24
			(1.31)			(3.62)***
R^2	0.35	0.49	0.52	0.12	0.12	0.40
SE	0.03	0.03	0.02	0.60	0.61	0.51
DW	1.97	1.87	1.72	2.09	2.09	2.24

Diagnostic Tests

Serial Correlation	X^2(1)=0.18 (0.672) F(1,29)=0.15 (0.702)	X^2(1)=0.29 (0.590) F(1,28)=0.23 (0.632)	X^2(1)=2.17 (0.141) F(1,27)=1.78 (0.193)	X^2(1)=1.88 (0.170) F(1,29)=1.65 (0.210)	X^2(1)=2.23 (0.136) F(1,28)=1.90 (0.179)	X^2(1)=1.57 (0.210) F(1,27)=1.27 (0.270)
Functional Form	X^2(1)=2.21 (0.137) F(1,29)=1.95 (0.173)	X^2(1)=7.43 (0.006) F(1,28)=7.55 (0.010)	X^2(1)=7.96 (0.005) F(1,27)=7.94 (0.009)	X^2(1)=3.00 (0.083) F(1,29)=2.72 (0.110)	X^2(1)=3.59 (0.058) F(1, 28)=3.20 (0.084)	X^2(1)=0.37 (0.544) F(1,27)=0.29 (0.597)
Normality	X^2(2)=14.71 (0.001)	X^2(2)=6.70 (0.035)	X^2(2)=7.60 (0.022)	X^2(2)=2.69 (0.260)	X^2(2)=2.82 (0.244)	X^2(2)=4.86 (0.088)
Heteroskeda-sticity	X^2(1)=0.47 (0.494) F(1,33)=0.45 (0.508)	X^2(1)=0.52 (0.470) F(1,33)=0.50 (0.484)	X^2(1)=0.54 (0.463) F(1,33)=0.52 (0.477)	X^2(1)=9.08 (0.003) F(1,33)=11.56 (0.002)	X^2(1)=8.85 (0.003) F(1,33)=11.17 (0.002)	X^2(1)=0.28 (0.596) F(1,33)=0.27 (0.609)

Causality Tests

LM	X^2(2)=3.99 (0.136)	X^2(2)=0.97 (0.616)	X^2(2)=0.69 (0.707)	X^2(2)=3.49 (0.174)	X^2(2)=3.50 (0.174)	X^2(2)=0.16 (0.922)
LR	X^2(2)=4.23 (0.120)	X^2(2)=0.98 (0.611)	X^2(2)=0.70 (0.705)	X^2(2)=3.68 (0.159)	X^2(2)=3.68 (0.159)	X^2(2)=0.16 (0.921)
F	F(2,30)=1.93 (0.163)	F(2,29)=0.41 (0.665)	F(2,28)=0.28 (0.756)	F(2,30)=1.66 (0.207)	F(2,29)=1.61 (0.217)	F(2,28)=0.07 (0.937)

Table A9. Granger Causality : VAR(2) for Spain

	Dependent DY			Dependent DSM		
	Eq. 8	**Eq. 10**	**Eq. 12**	**Eq. 9**	**Eq. 11**	**Eq. 13**
DY(-1)	0.57 (3.16)***	0.40 (2.19)**	0.43 (2.43)**	-0.79 (0.78)	-1.55 (1.45)	-0.67 (1.57)
DY(-2)	0.08 (0.47)	-0.15 (0.81)	-0.04 (0.19)	0.16 (0.17)	-0.87 (0.80)	-1.35 (1.19)
DSM(-1)	0.01 (0.30)	-0.02 (0.75)	-0.01 (0.31)	-0.01 (0.03)	-0.14 (0.82)	-0.20 (1.11)
DSM(-2)	0.01 (0.03)	-0.03 (0.84)	-0.01 (0.44)	0.04 (2.50)***	0.29 (1.73)*	0.24 (1.42)
Intercept	0.01 (1.82)*	0.03 (3.04)***	0.02 (2.51)**	0.01 (0.43)	0.09 (1.66)	0.11 (1.98)*
ECT(-1)	____	-0.04 (2.33)**	-0.03 (1.73)*	____	-0.16 (1.78)**	-0.21 (2.11)**
D8288	____	____	-0.04 (1.86)*	____	____	0.15 (1.29)
R^2	0.46	0.55	0.60	0.21	0.29	0.33
SE	0.02	0.02	0.02	0.11	0.11	0.10
DW	2.05	1.93	1.88	1.91	1.92	2.01
			Diagnostic Tests			
Serial Correlation	$X^2(1)=3.50$ (0.061) F(1,29)=3.22 (0.083)	$X^2(1)=0.05$ (0.828) F(1,28)=0.04 (0.847)	$X^2(1)=0.44$ (0.505) F(1,27)=0.35 (0.561)	$X^2(1)=0.12$ (0.726) F(1,29)=0.10 (0.751)	$X^2(1)=0.24$ (0.625) F(1,28)=0.19 (0.665)	$X^2(1)=0.01$ (0.922) F(1,27)=0.01 (0.932)
Functional Form	$X^2(1)=0.17$ (0.680) F(1,29)=0.14 (0.709)	$X^2(1)=0.08$ (0.781) F(1,28)=0.06 (0.805)	$X^2(1)=0.94$ (0.332) F(1,27)=0.75 (0.396)	$X^2(1)=1.90$ (0.168) F(1,29)=1.67 (0.207)	$X^2(1)=0.49$ (0.482) F(1,28)=0.40 (0.531)	$X^2(1)=0.02$ (0.878) F(1,27)=0.02 (0.893)
Normality	$X^2(2)=0.26$ (0.879)	$X^2(2)=1.82$ (0.403)	$X^2(2)=0.95$ (0.623)	$X^2(2)=1.33$ (0.515)	$X^2(2)=1.45$ (0.485)	$X^2(2)=0.93$ (0.629)
Heteroskeda-sticity	$X^2(1)=1.37$ (0.242) F(1,33)=1.34 (0.255)	$X^2(1)=1.72$ (0.189) F(1,33)=1.71 (0.200)	$X^2(1)=2.80$ (0.095) F(1,33)=2.86 (0.100)	$X^2(1)=0.01$ (0.954) F(1,33)=0.01 (0.956)	$X^2(1)=0.14$ (0.712) F(1,33)=0.13 (0.721)	$X^2(1)=0.09$ (0.769) F(1,33)=0.08 (0.777)
			Causality Tests			
LM	$X^2(2)=0.10$ (0.950)	$X^2(2)=1.20$ (0.549)	$X^2(2)=0.29$ (0.865)	$X^2(2)=1.03$ (0.597)	$X^2(2)=4.23$ (0.121)	$X^2(2)=5.69$ (0.058)
LR	$X^2(2)=0.10$ (0.950)	$X^2(2)=1.22$ (0.543)	$X^2(2)=0.29$ (0.864)	$X^2(2)=1.05$ (0.593)	$X^2(2)=4.51$ (0.105)	$X^2(2)=6.21$ (0.045)
F	F(2,30)=0.04 (0.957)	F(2,29)=0.51 (0.603)	F(2,28)=0.12 (0.890)	F(2,30)=0.45 (0.639)	F(2,29)=1.99 (0.154)	F(2,28)=2.72 (0.083)

Table A10. Granger Causality: VAR(2) for Portugal

	Dependent DPORY			Dependent DPORSM		
	Eq. 8	**Eq. 10**	**Eq. 12**	**Eq. 9**	**Eq. 11**	**Eq. 13**
DY(-1)	0.40 (2.31)**	0.37 (2.16)**	0.11 (0.56)	6.28 (1.96)*	5.53 (1.78)*	4.27 (1.10)
DY(-2)	- 0.03 (0.17)	0.01 (0.04)	-0.14 (0.75)	-1.70 (0.50)	-0.43 (0.13)	-1.13 (0.32)
DSM(-1)	- 0.01 (1.54)	-0.01 (1.36)	-0.01 (1.28)	- 0.17 (0.95)	-0.11 (0.68)	-0.11 (0.63)
DSM(-2)	0.01 (1.48)	0.01 (1.33)	0.01 (0.48)	- 0.08 (0.58)	-0.12 (0.85)	-0.15 (0.99)
Intercept	0.02 (2.37)**	0.02 (2.41)**	0.03 (3.02)***	- 0.34 (1.77)*	-0.33 (1.75)*	-0.30 (1.56)
ECT(-1)	____	-0.03 (1.00)	-0.02 (0.72)	____	-0.94 (1.85)*	-0.90 (1.73)*
D6074	____	____	0.03 (2.27)**	____	____	0.16 (0.56)
R^2	0.23	0.25	0.37	0.15	0.24	0.25
SE	0.03	0.03	0.03	0.56	0.54	0.55
DW	1.99	1.98	1.83	1.96	1.90	1.88
			Diagnostic Tests			
Serial Correlation	$X^2(1)$=0.001 (0.965) F(1,29)=0.001 (0.968)	$X^2(1)$=0.02 (0.880) F(1,28)=0.02 (0.894)	$X^2(1)$=3.70 (0.054) F(1,27)=3.19 (0.085)	$X^2(1)$=0.09 (0.762) F(1,29)=0.08 (0.785)	$X^2(1)$=0.77 (0.380) F(1,28)=0.63 (0.434)	$X^2(1)$=1.04 (0.307) F(1,27)=0.83 (0.370)
Functional Form	$X^2(1)$=6.60 (0.010) F(1,29)=6.74 (0.015)	$X^2(1)$=5.79 (0.016) F(1, 28)=5.55 (0.026)	$X^2(1)$=6.76 (0.009) F(1,27)=6.47 (0.017)	$X^2(1)$=5.81 (0.016) F(1,29)=5.78 (0.023)	$X^2(1)$=17.18 (0.000) F(1,28)=26.98 (0.000)	$X^2(1)$=17.68 (0.000) F(1,27)=27.58 (0.000)
Normality	$X^2(2)$=0.73 (0.695)	$X^2(2)$=0.61 (0.736)	$X^2(2)$=1.54 (0.463)	$X^2(2)$=5.26 (0.072)	$X^2(2)$=1.33 (0.513)	$X^2(2)$=2.07 (0.355)
Heteroskeda -sticity	$X^2(1)$=1.57 (0.210) F(1,33)=1.55 (0.222)	$X^2(1)$=0.46 (0.499) F(1,33)=0.44 (0.513)	$X^2(1)$=1.62 (0.203) F(1,33)=1.60 (0.215)	$X^2(1)$=14.10 (0.000) F(1,33)=22.26 (0.000)	$X^2(1)$=11.05 (0.001) F(1,33)=15.23 (0.000)	$X^2(1)$=12.97 (0.000) F(1,33)=19.42 (0.000)
			Causality Tests			
LM	$X^2(2)$=4.80 (0.091)	$X^2(2)$=3.94 (0.139)	$X^2(2)$=2.18 (0.336)	$X^2(2)$=3.97 (0.137)	$X^2(2)$=3.67 (0.160)	$X^2(2)$=1.54 (0.464)
LR	$X^2(2)$=5.16 (0.076)	$X^2(2)$=4.18 (0.124)	$X^2(2)$=2.25 (0.325)	$X^2(2)$=4.21 (0.122)	$X^2(2)$=3.87 (0.144)	$X^2(2)$=1.57 (0.456)
F	F(2,30)=2.38 (0.109)	F(2,29)=1.84 (0.177)	F(2,28)=0.93 (0.407)	F(2,30)=1.92 (0.164)	F(2,29)=1.70 (0.201)	F(2,28)=0.64 (0.534)

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